Front-loading washing machine with a rotating washing drum

[001] The invention relates to a front-loading washing machine with a rotating drum, whose drum shell is provided with flow perforations for exchanging washing liquid between the interior of the washing drum and the interior of a liquid container surrounding said drum and whose lowest shell line in the operating position of the washing machine differs from a horizontal, ascending towards the front, with hollow elongated carriers which are configured such that they take up quantities of liquid from their lowest position and raise said liquid as the washing drum rotates and release said liquid from a raised position into the interior of the washing drum.

[002] In washing machines it has been prior art for a long time to wet the laundry to be washed with washing liquid and move said laundry mechanically to release contaminants. In drum washing machines this function is performed by a washing drum located substantially horizontally in a liquid container for receiving the laundry, which drum is set in rotation and thereby moves the laundry in its interior. In order to assist this function, it has long been known to dispose elongated, rib-shaped carriers internally on the shell of the washing drum, these being aligned transverse to the direction of movement of the washing drum shell. Entraining ribs fixed internally to a washing drum are already known from DE-PS 8 347 from 1879 and have long been used almost exclusively for movement of the laundry in drum washing machines.

[003] In addition, some drum washing machines are known wherein the carriers are positioned obliquely and run substantially along a helical line internally on the shell of the washing drum. In all cases, the oblique positioning of the carriers is made with the aim of influencing the movement of the laundry or the input of mechanical energy to the laundry. Drum washing machines of this type are known for example from DE-PS 537 758, DE-PS 576 523, FR 1 136 981 and DE 44 12 718 A1. Furthermore, drum washing machines are also known wherein axial transport of the laundry inside the drum during its rotation is achieved with the oblique positioning of the carriers. In the drum washing machine known from DE-GM 88 04 246 the removal of the laundry is assisted in this way.

[004] In addition, a washing machine is also known (DE 199 25 917 A1) wherein the carriers scoop water in the lowest area of the liquid container in order to raise said water and sprinkle it from an elevated position through openings onto the laundry located thereunder. At the same time, they convey the absorbed liquid towards the front where the scooped quantity of liquid can no longer reach small batches of laundry which are transported into the rearward region (away from the loading opening) when the lower shell line is obliquely positioned. As a result, the process of wetting small batches of laundry is delayed and ineffective because the released quantities of liquid run through the flow perforations of the drum shell before they can reach the laundry.

[005] It is thus the object of the invention to improve the wettability in particular of small batches of laundry in a washing machine described hereinbefore.

[006] This object is achieved according to the invention whereby in its front region which measures about a quarter to about a third of the total depth of the washing drum, the drum shell has a total area of flow perforations reduced by at least 50% compared with rear region. This measure has the consequence that quantities of liquid raised by the carriers and transported forwards rain over the less perforated region and then flow towards the laundry on the shell inner surface. This shortens the wetting process compared with the prior art and supplies small batches of laundry to more efficient wetting. In addition, the exchange of liquid is intensified for the entire washing process.

[007] Since the rear perforated surfaces are predominantly covered by laundry during spinning and then only the front perforated surfaces undergo air exchange with the interior of a surrounding liquid container, the measure according to the invention further brings about a reduction in the so-called radial pumping effect of the rotating washing drum whereby air is sucked from the liquid container from the loading opening at the front and is pressed back into the liquid container again by uncovered flow perforations. This effect has the result that liquid which has been spun out from the sleeve area of the loading opening is entrained and undesirably wets the laundry again.

[008] The effects of the measure according to the invention can best be achieved if the front region has no flow perforations.

[009] If, according to an advantageous embodiment of the invention, the flow perforations in the front region are the same size as those in the rear region but are reduced in number compared thereto or those in the front region have a smaller inside diameter compared with those in the rear region, the wetting is likewise already appreciably accelerated. At higher liquid levels in the liquid container, e.g. during rinsing of the laundry, the flow perforations in the front region, although few in number, can still be helpful.

[010] In one embodiment wherein no flow perforations are arranged in the front region, it can be particularly advantageous that the perforation-free front region is provided with groove-like embossings. The embossings should be placed in a direction which promotes the draining of spun-out water. This will particularly be the case if, according to an advantageous embodiment of the invention, the groove-like embossings point towards flow spacings in the rear region and end in front of the rear region.

[011] The invention is explained in detail hereinafter with reference to exemplary embodiments shown in the drawings. In the figures

[012] Fig. 1 is a lateral view through the vibrating unit of a washing machine according to the invention comprising a liquid container and washing drum with carriers,

[013] Fig. 2 is a flat section of a sheet metal section of the shell of a first variant of a washing drum configured according to the invention,

[014] Fig. 3 is a diagram of a second variant according to Fig. 2,

[015] Fig. 4 is a diagram of a third variant according to Fig. 2 and

[016] Fig. 5 is a diagram of a fourth variant according to Fig. 2.

[017] Of the washing machine shown in Fig. 1, the suspended unit 1 and the corrugated tube 2 with the discharge pump 3 connected at the bottom are shown schematically.

[018] The unit 1 is suspended in a movable manner (not shown) and includes the liquid container 4 and the washing drum 5 mounted at least approximately concentrically therein. The unit 1 is suspended or positioned obliquely in a housing of the washing machine in such a manner that the axis of rotation 6 of the laundry drum 5 ascends at an angle of about 5° from horizontal for example, towards the front loading opening 7 of the liquid container 4. The loading opening is thereby tilted towards the user in a user-friendly manner.

[019] The washing drum 5 is mounted with a hub 8 at the rear 9 of the liquid container 4 in a usual manner using a stable pin 10. The drum 5 is cylindrical; consequently, the lower shell line 11 of the washing drum 5 ascends towards the front by the same angle as its axis of rotation 6. As shown in Fig. 1, three carriers 12 are distributed uniformly on the inner shell of the drum 5. The carriers 12 are used on the one hand in the usual manner to lift laundry during rotation of the washing drum 5, this laundry being mechanically processed whereby after being raised from a more or less great height, it falls back to the bottom of the drum again and thereby releases dirt portions together with the liquid which is wetting it.

[020] However, these carriers 12 are also used to scoop liquid which is located during the washing process as a portion of free liquid 13 located inside the liquid container 4 in the rear lower portion of the liquid container 4. Portions of the free liquid are removed by each carrier 12 via liquid inlets 14 whenever the relevant carrier is located at the lowest point of its path. The carriers 12 are mounted obliquely to the direction of rotation of the washing drum 12 contrary to the otherwise usual rectangular mounting position. They are also curved convexly in the direction of rotation of the drum. Consequently, the scooped liquid inside the carriers 12 is raised upwards during rotation of the drum and is transported forwardly inside the carrier 12 by the same amount as the curvature of the carrier tips over slowly towards the front during rotation.

[021] The carriers 12 have various openings 16 for releasing the scooped quantities of liquid, particularly on their convexly curved flanks 15 in the front area. In the concave flank 17, the

carriers have no such openings or only very few such openings and these merely at the front and very close to the ridge edge 18. It is thereby achieved that most of the scooped quantities of liquid can be poured over the portions of laundry located at the front. At the same time, however, as a result of the oblique position of the axis of rotation 6, considerable portions of the scooped quantities of liquid are delivered to the portions of laundry located further back in the drum 5.

[022] It is not shown in Fig. 1 that the shell of the washing drum 5 is perforated by means of flow perforations such that a continuous exchange of liquid can take place between the interior of the rotating laundry drum 5 and the free liquid 13. This is of considerable importance for a good laundry cleaning effect. It is always strived for that as much liquid as possible floods the laundry per unit time. However, if, as is usual in the prior art, flow perforations are arranged in the front area of the drum shell according to a washing machine described previously, then too much of the liquid rained over the laundry by the scooping carriers passes immediately through these flow perforations without wetting said laundry and released from the drum again at that point. This effect is naturally strongest the smaller the amount of laundry in the drum; this is because if the frontmost flow perforations are exposed because of the small amount of laundry, most of the rained amount of water escapes through these flow perforations without having touched the laundry at all.

[023] In order to avoid this disadvantage, the washing drum of a washing machine constructed according to the invention has no flow perforations or only a reduced number or size of flow perforations in the front area so that any rained quantity of liquid which has not yet been taken up by the laundry remains for a sufficiently long time at the bottom of the front region of the washing drum until it has been sucked up by the laundry located thereabove.

[024] In the exemplary embodiment of the invention according to Fig. 2, no flow perforations are provided in the front region 19 of the drum shell 20 unlike in the rear region 21 wherein flow perforations 22 are arranged in the usual manner. This surface is completely impermeable to water so liquid impinging upon this surface from above can be held available for wetting the laundry for the longest time.

[025] However, since it is rather an impediment if water or liquid remains too long at the bottom of the washing drum, e.g. for intensive flooding of the laundry with a high liquid level or for removal of water during spinning, it can be advantageous if, according to a further development of the invention, the entire area of all the flow perforations arranged in the front region is reduced compared with the remaining region. This can be achieved by a reduction in the number of flow perforations 23 of otherwise the same size as in Fig. 3 or by a same number of flow perforations 24 of reduced cross-section as in Fig. 4. Any type of mixed forms where flow perforations having a plurality of different diameters or cross-sections can be used are also feasible under the same inventive idea.

[026] During spinning, for example, it can be important that water which has been spun out is removed as rapidly as possible from the washing drum. This could be assisted according to Fig. 5 by providing groove-shaped indentations 25 in this front region 19 which are directed towards the region 21 provided with conventional flow perforations 22. In this case, depending on the direction of spinning, the grooves can be coiled helically in one or other or in both directions. For immediate removal of water collected in this manner, it is helpful if the grooves in the region 21 of the conventional flow perforations reach the frontmost flow perforations.